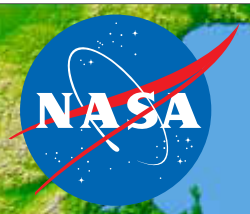
National Aeronautics and Space Administration



Kinematic slip model for 12 May 2008 Wenchuan-Beichuan Mw 7.9 earthquake from joint inversion of ALOS, Envisat & Teleseismic

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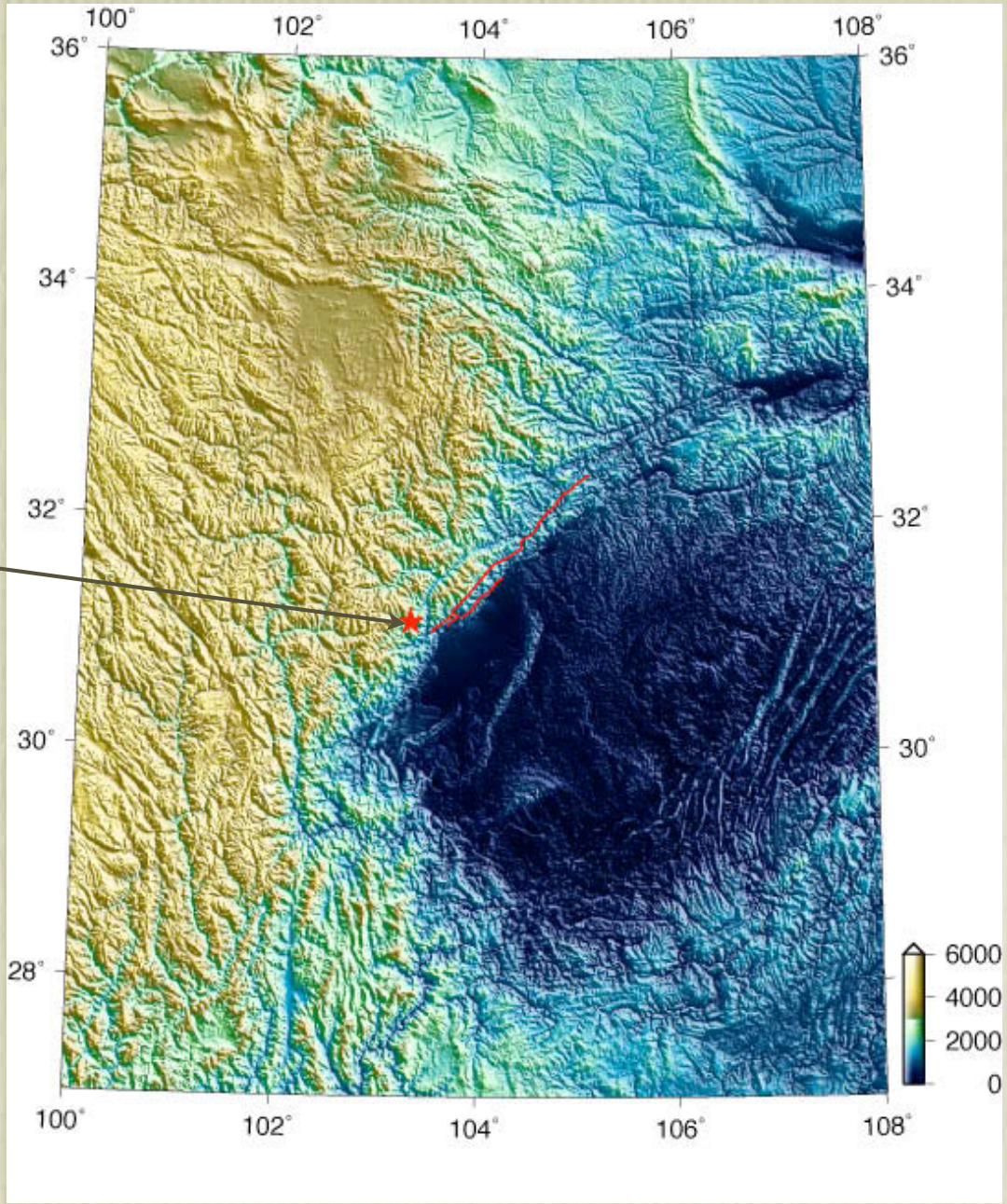
* Work partially performed under contract with the National Aeronautics and Space Administration

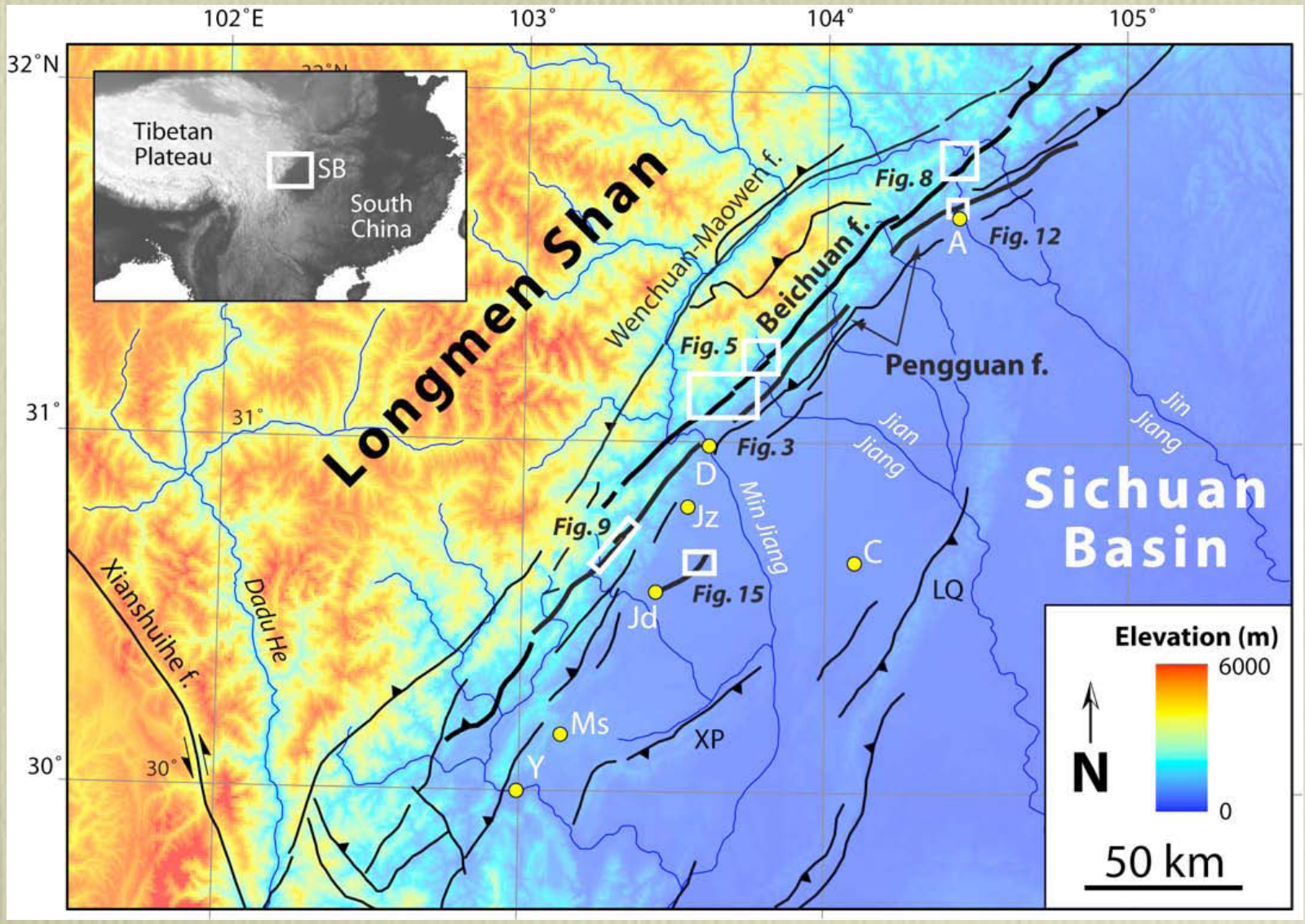
Wenchuan-Beichuan earthquake

- eastern Sichuan province
- 12 May 2008, Mw 7.9
- >70,000 fatalities
- epicenter at SW end
- surface ruptures 250 km along mountain front
- steep Longmen Shan mountains at east edge of Tibetan plateau



Geomorphic mapping

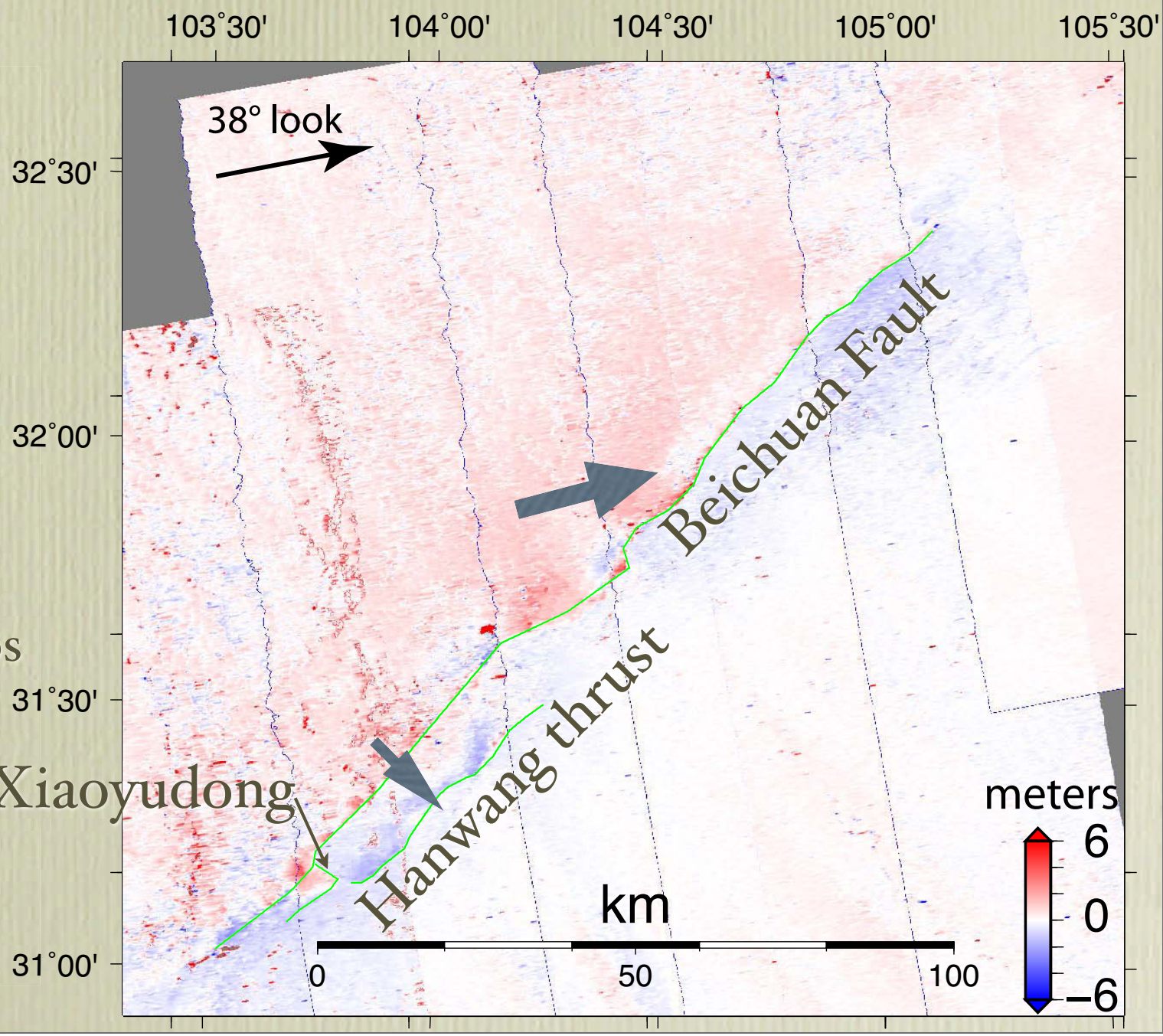
Active faults mapped before earthquake



Densmore et al., *Tectonics*, 2007

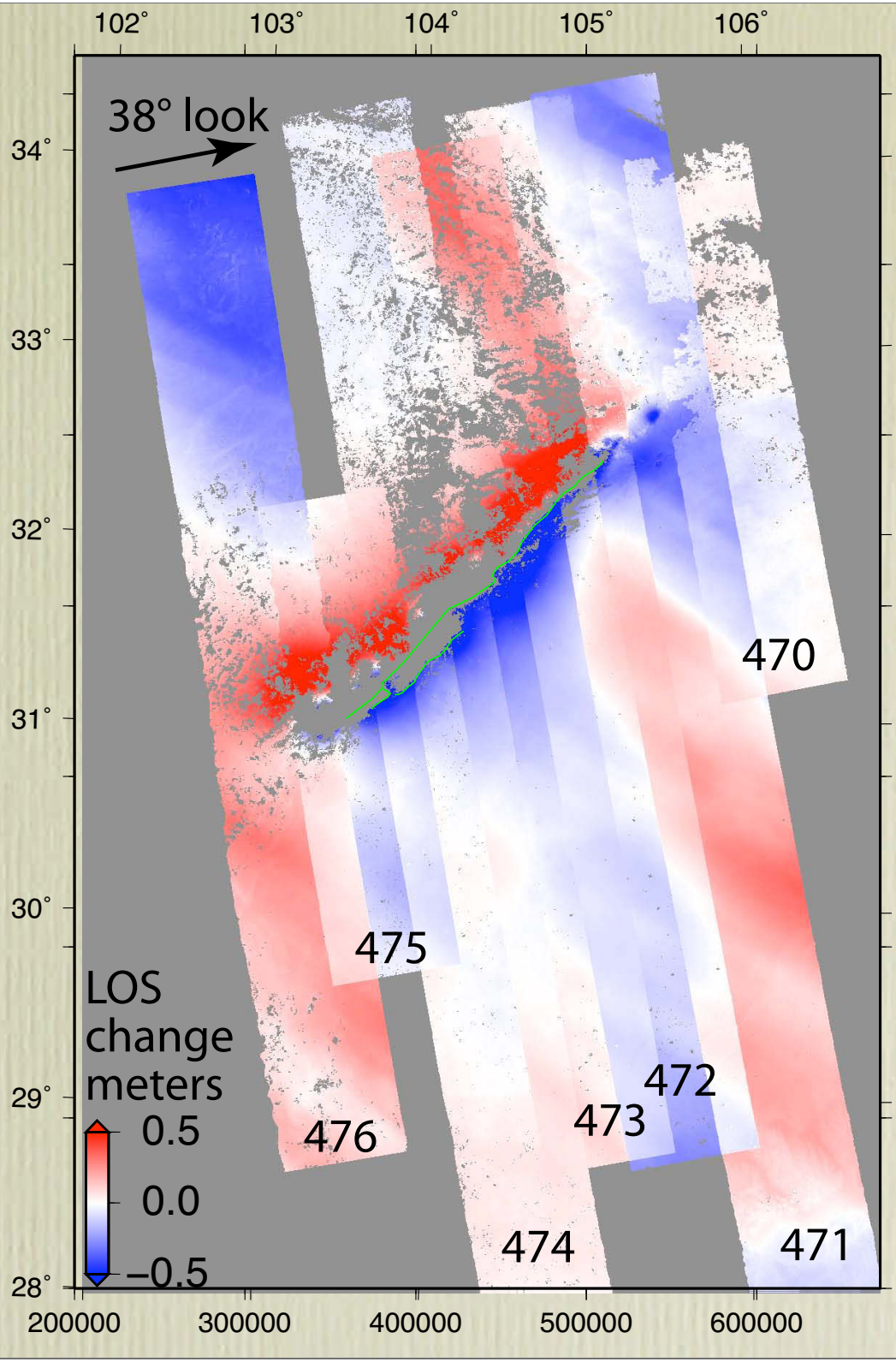
ALOS PALSAR range offsets

- Range offsets measure LOS displacement like InSAR
- combination of vertical and horizontal motion
- Discontinuity maps surface ruptures
- PALSAR azimuth offsets heavily contaminated



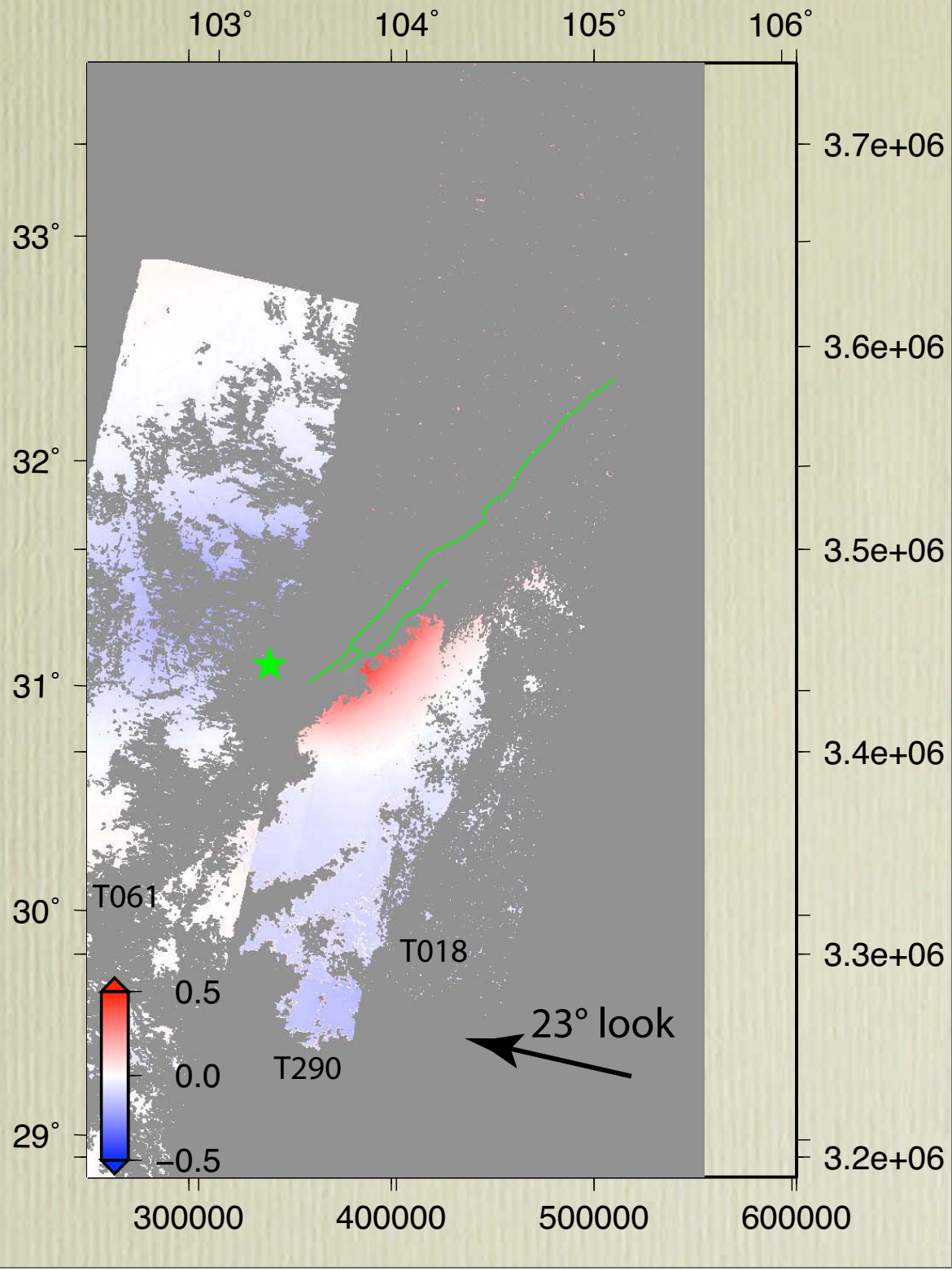
ALOS PALSAR interferometry

- six paths cover rupture, plus two at ends
- ROI_pac processing & SNAPHU unwrapping
- coherence lost in steep slopes with longer baselines, and where displacements large
- artifact waves cause up to 1 m of range change variations



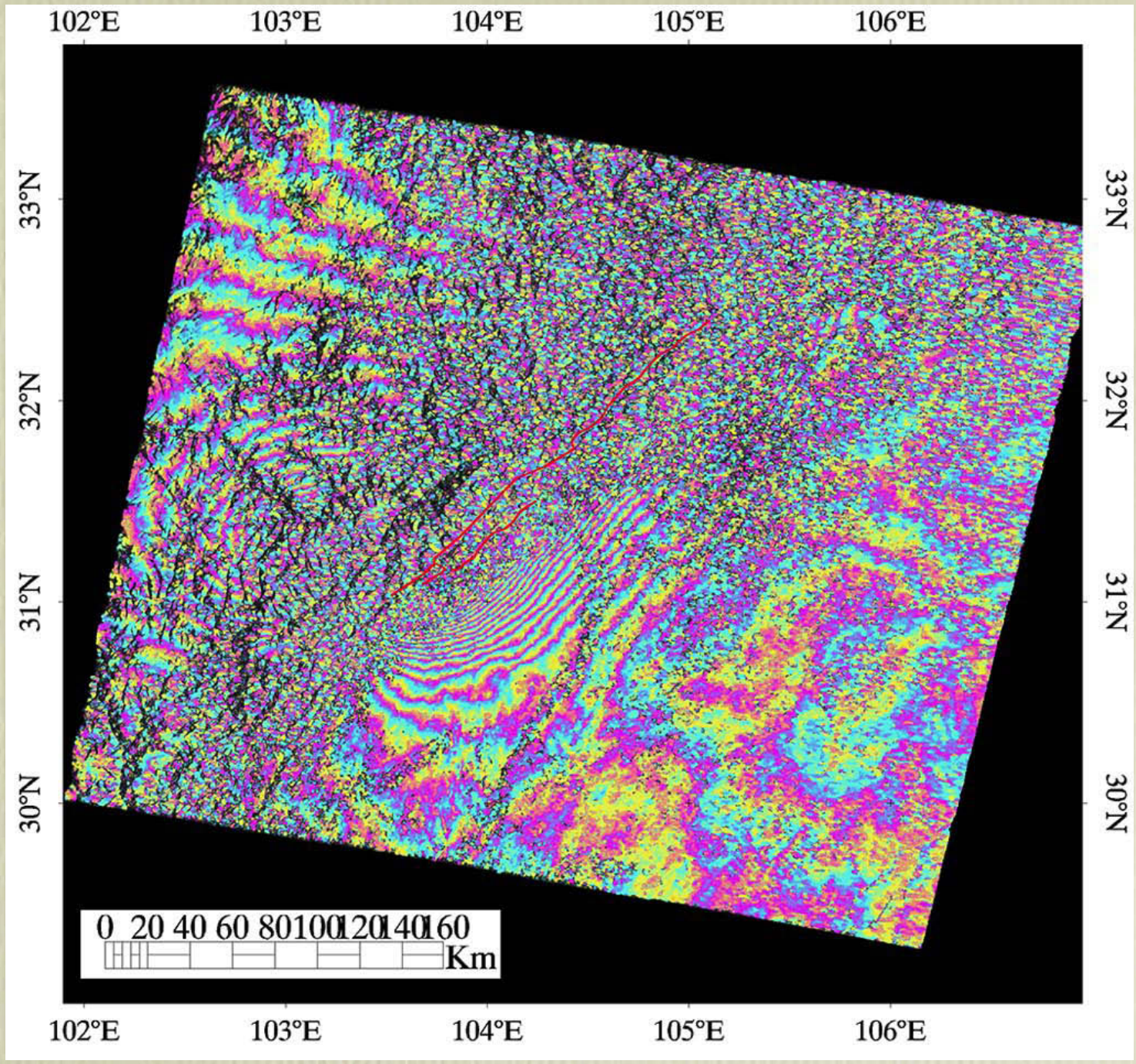
Envisat IM interferometry

- three descending tracks in image mode (strip map)
- long time intervals and baselines
- poor coherence except in plains, less steep mountains
- vertical and horizontal motion add



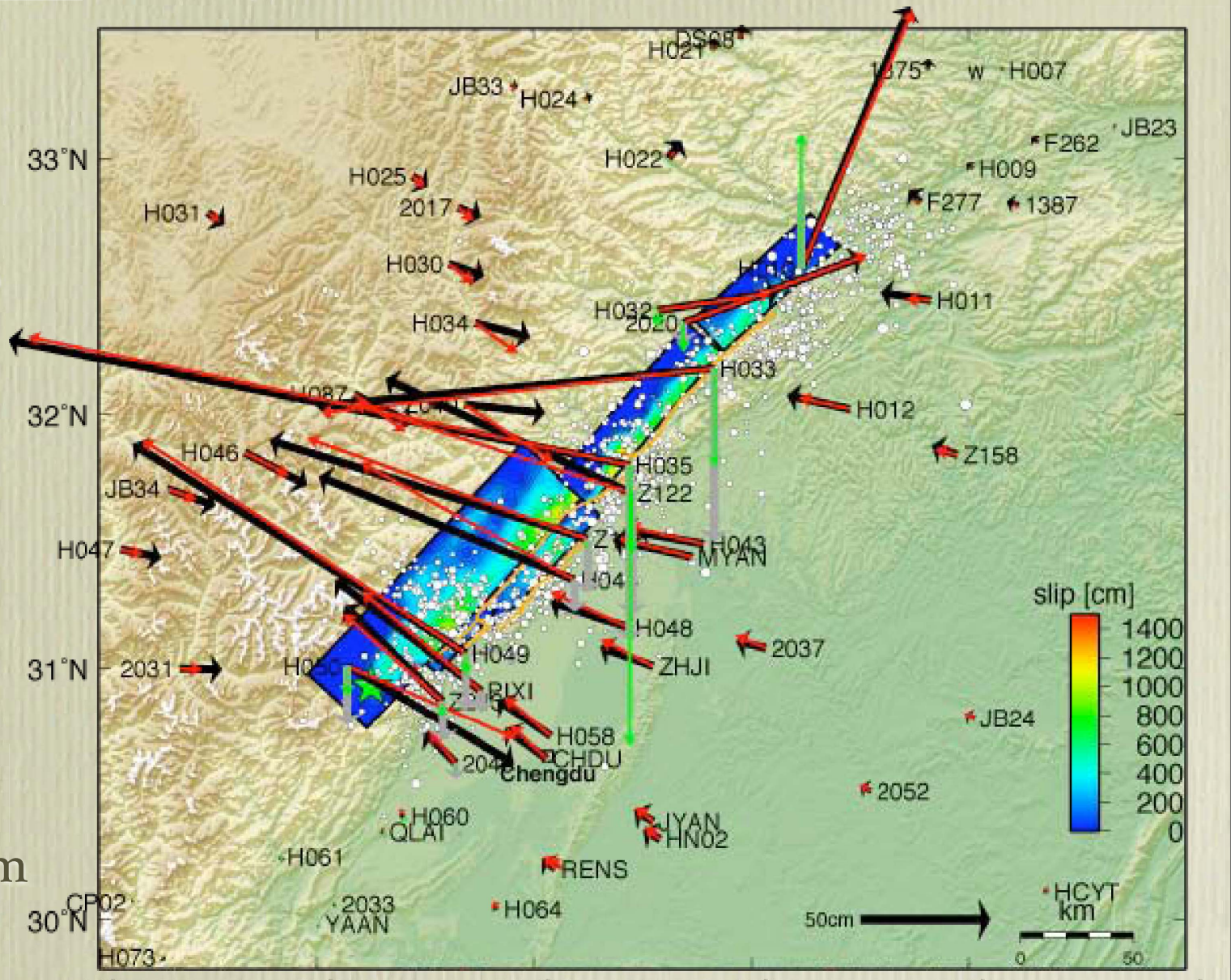
Envisat ScanSAR

- WS mode pairs acquired on three tracks
- Track 476 pair best baseline and burst sync.
- 2007/07/15–2008/06/29
- low coherence but fringes after strong smoothing



Joint GPS-InSAR inversion (static)

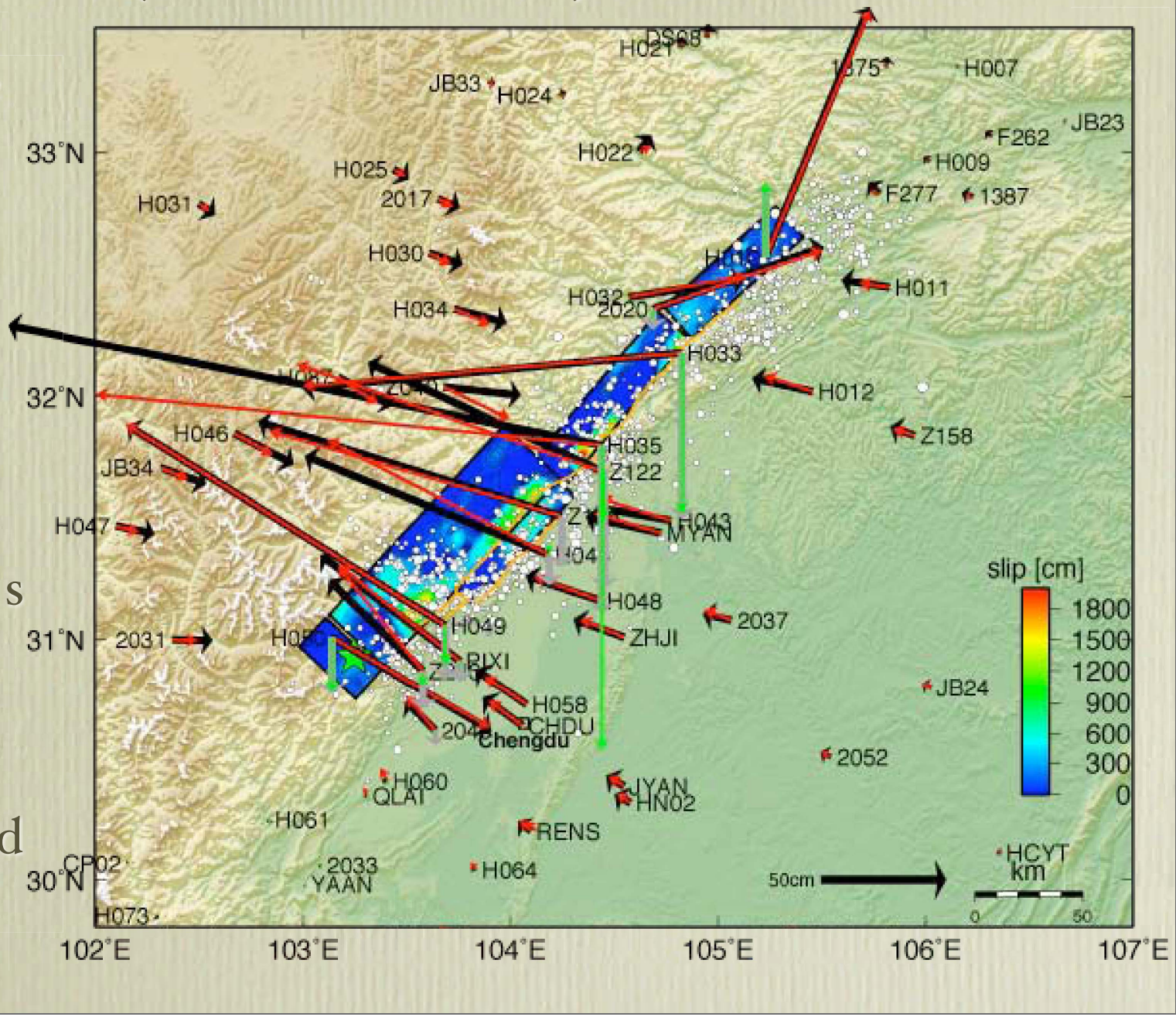
- six PALSAR ascending, three ASAR descending
- Five fault segments
  - Beichuan fault dipping at 33° (south) and 51° (north)
  - Hanwang faults dipping at 20°
- coseismic GPS from CMONOC (black and gray arrows)



red & green: predicted horizontal & vertical

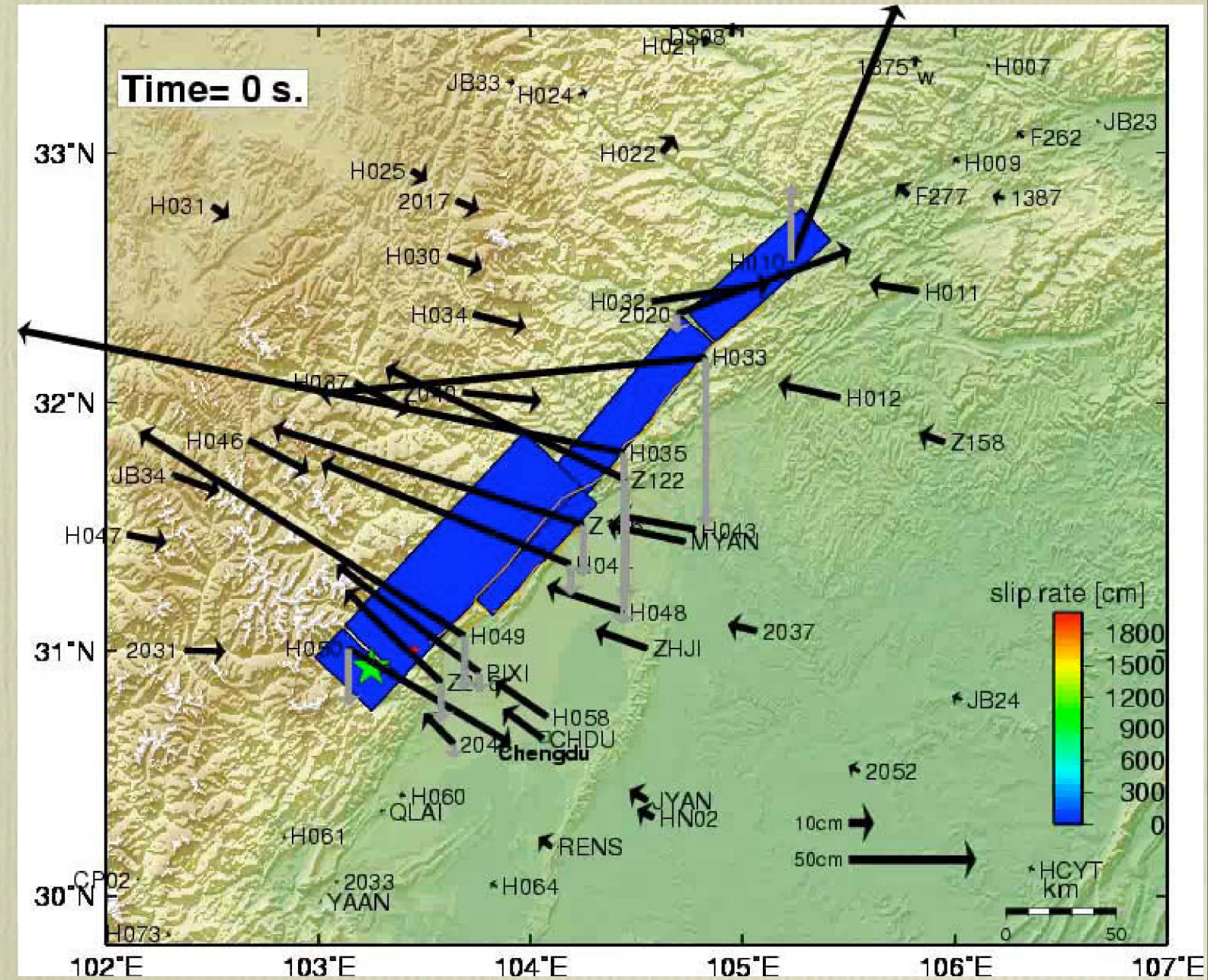
Joint GPS-teleseismic inversion (kinematic)

- modified C. Ji code
- 21 P and 15 SH waveforms
- five fault segments
- Beichuan fault (south) split with 8 s delay 1st to 2nd segment
- hypocenter adjusted 15 km to SW

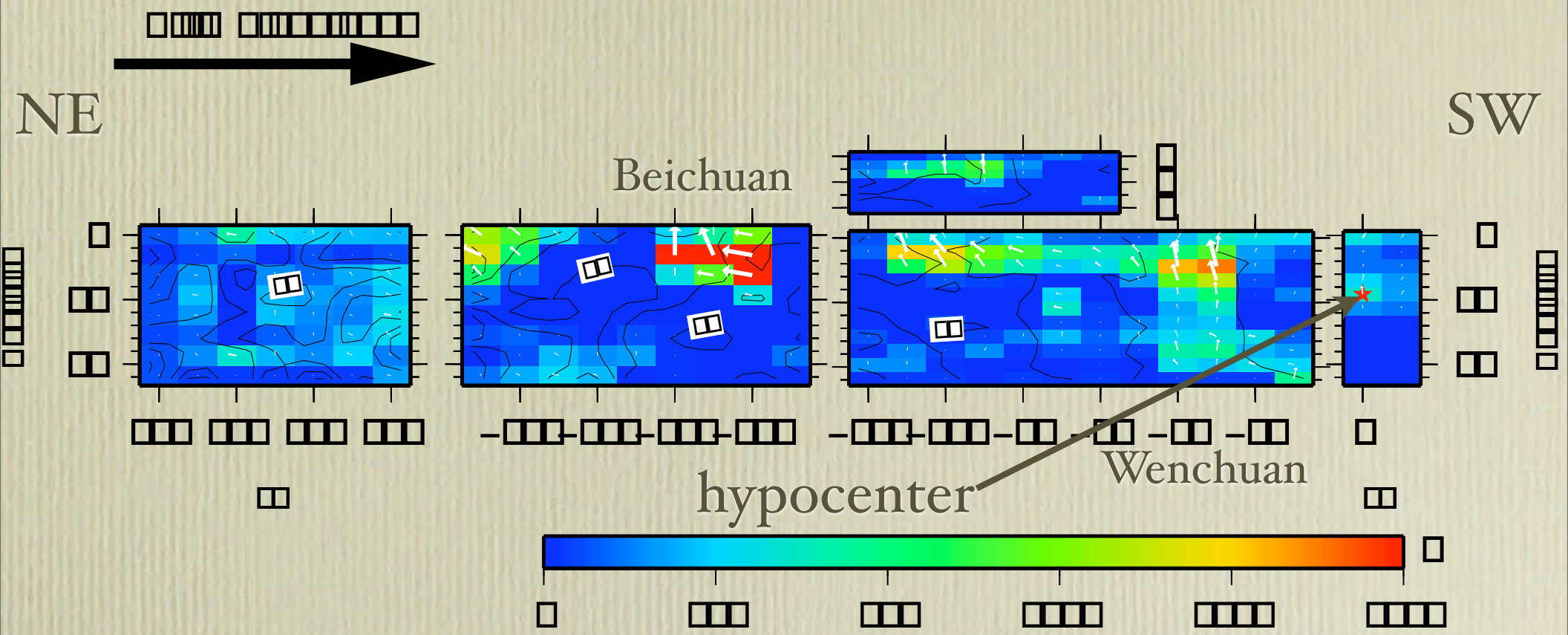


Joint GPS-teleseismic inversion

- animation of cumulative slip
- total slip at each second of rupture model
- quasi-static displacements at GPS stations
- played at four times faster than real time



Joint GPS-teleseismic inversion



- 8 s delay from 1st to 2nd rupture
- early slip nearly pure thrust
- later slip much more strike-slip
- most slip shallow <10 km, except near Wenchuan & NE
- landslides of Beichuan area over largest slip

Conclusions

- Beichuan fault system was main rupture, with rotation of slip: thrust to right-lateral from SW to NE
- Hanwang fault in Pengguan fault system had large thrust motion, shallow block near Xiaoyudong also had large lateral motion
- Joint inversions with InSAR, GPS, and teleseismic combine time and space constraints on kinematics
- InSAR angle diversity necessary for understanding complex rupture
- SAR pixel offsets map near-fault large deformations and surface ruptures